

Chapter 1

The Virginia Energy Plan

Executive Summary

The purpose of the Virginia Energy Plan is to chart a path forward that will provide for reliable energy supplies at reasonable rates and increase the use of conservation and efficiency measures in Virginia.

1.0 Introduction

The purpose of the Virginia Energy Plan is to chart a path forward that will provide for reliable energy supplies at reasonable rates and increase the use of conservation and efficiency measures in Virginia. The Plan has been developed in accordance with 2006 legislation (Title 67 of the Code of Virginia; see Appendix B) that set out energy policy statements and objectives and directed the Department of Mines, Minerals and Energy to develop a ten-year state energy plan. The Plan is to be updated every five years.

This Plan was developed using information gathered from the Virginia Energy Plan Advisory Group (see Appendix A for a list of members), which met five times to address the Plan's major components. The Plan is also the product of input received at five public workshops held around the state and from public comments submitted via the Internet. The plan has been reviewed by the Department of Environmental Quality and other state agencies, State Corporation Commission staff, and the Virginia Center for Coal and Energy Research. The research and development recommendations are derived from a study by the Center for Innovative Technology.

The Virginia General Assembly set out energy policy statements and objectives in the Code of Virginia at sections 67-101 and 67-102. These call for Virginia to take a broad range of energy actions, including:

- Ensure the availability of reliable energy at costs that are reasonable and that advance the health, welfare, and safety of Commonwealth residents.
- Establish sufficient energy supply and delivery infrastructure, including that needed to support the availability of natural gas, in the Commonwealth.
- Use energy resources efficiently and facilitate conservation.
- Facilitate development of low-cost energy resources located both within and outside the Commonwealth, including development of clean coal resources.

- Facilitate development of energy sources that are less polluting of the Commonwealth's air and water, and electric generation technologies that do not contribute to greenhouse gases and global warming.
- Ensure the economic viability of Virginia's producers of low-cost energy resources.
- Foster research and development of alternative energy sources that are competitive at market prices.
- Develop energy resources and facilities that do not impose a disproportionately adverse impact on economically disadvantaged or minority communities.
- Increase Virginia's reliance on agricultural-based ethanol and biodiesel from crops grown in the Commonwealth.
- Ensure that energy generation and delivery systems are located in places that minimize impacts to pristine natural areas and other significant onshore natural resources, and that are as near as possible to compatible development.

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Meeting the goals of this Plan and implementing the energy policy and objectives set out in the 2006 energy policy legislation will require actions by individuals, businesses, and government institutions.

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Virginia must overcome market, consumer-education, historical energy-cost, public policy, and institutional barriers in order to meet these energy policies and objectives. Overcoming these barriers will require a mix of public and private investments.

Virginia Energy Plan 2017 Goals

- **Increase energy independence, with an emphasis on conservation and clean fuel technologies, by:**
 - Reducing the rate of growth of energy use by 40 percent. This will reverse the projected growth in per capita energy use and result in a nearly level per capita energy use per year.
 - Increasing Virginia's indigenous energy production by 20 percent.
- **Expand consumer energy education to overcome barriers to implementing energy-efficiency and conservation actions.**
- **Reduce greenhouse gas emissions by 30 percent by 2025, bringing emissions back to 2000 levels.**
- **Capitalize on economic development opportunities through business expansion and increased research and development in areas of strength, including alternate transportation fuels, nuclear technology, coastal energy production, and carbon capture and storage.**

Meeting the goals of this Plan and implementing the energy policy and objectives set out in the 2006 energy policy legislation will require actions by individuals, businesses, and government institutions. Individuals, business, and government will need to work together to increase energy-efficiency and conservation

actions, provide for a diverse portfolio of energy supplies including traditional and alternate energy sources, provide the needed infrastructure to deliver conservation services and energy supplies, and provide for focused research, development, and deployment of new energy technologies.

Through these efforts, Virginia will increase the role of energy efficiency and conservation, support existing businesses with reliable low-cost energy supplies, support new job growth, increase energy-education activities, increase energy assistance to low-income Virginians, and increase energy research and development at our universities and businesses. Virginians will see lower energy costs in the short term through energy-efficiency and conservation actions, and have a more secure energy future because of investments in new energy infrastructure, energy research and development, and new energy businesses.

The Commonwealth should ensure that these activities are effective in meeting Virginia's energy goals. The Governor's Energy Policy Advisory Council, with assistance from the Department of Mines, Minerals and Energy and other state agencies and institutions, should evaluate the energy saved, new supplies of energy generated, and value of investments in energy research and development and new business development. The results of the evaluation should be reported to the Governor and the General Assembly to ensure accountability of the proposed energy activities.

1.1.1 Supply and Consumption of Energy in Virginia

Virginia's energy needs are met by a combination of in-state production and imports. Sources include coal, natural gas, uranium, hydropower, petroleum, and renewable sources. The state is a net exporter of coal and produces natural gas in an amount equal to approximately one-third of state consumption. All other fuels are imported from other states and foreign countries (see Figure 1-1).

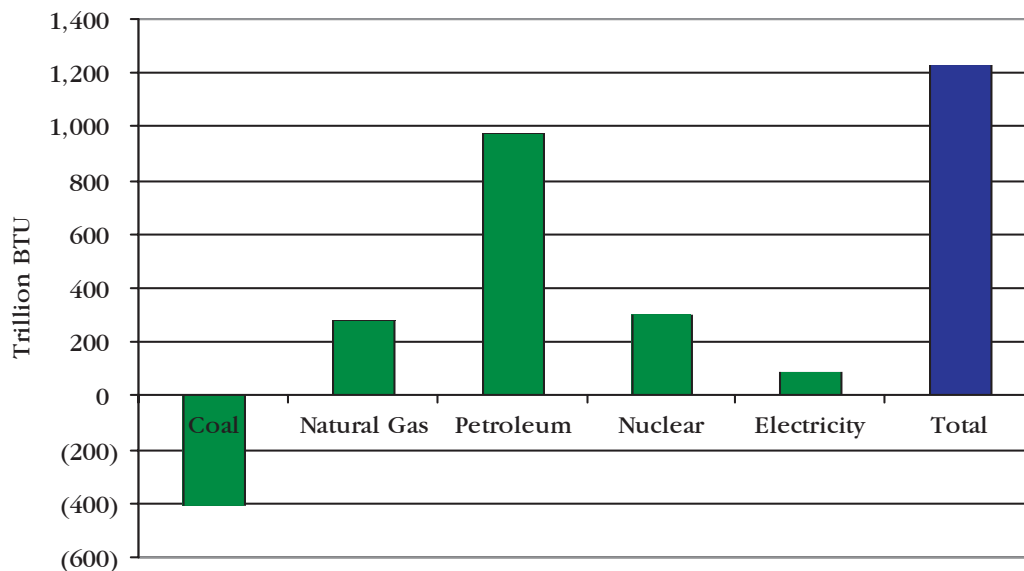
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Transportation is the single largest energy-using sector, accounting for approximately 43 percent of total energy use in the state.

Figure 1-1 Net Imports of Energy into Virginia

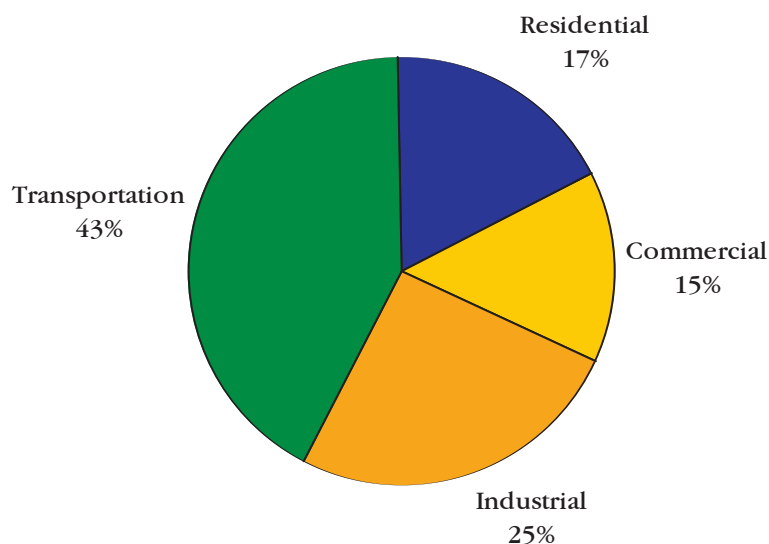


Approximately three-quarters of the electricity used in Virginia is produced inside the state from in-state supplies of coal, natural gas, and renewable resources, and from imported uranium, coal, natural gas, and petroleum. The balance of electricity is imported from other states.

Transportation is the single largest energy-

using sector, accounting for approximately 43 percent of total energy use in the state (see Figure 1-2). Virginia's building stock accounts for approximately 57 percent of total energy used. Of that, 17 percent is used in the residential sector, 15 percent in the commercial sector, and 25 percent in the industrial sector.

Figure 1-2 Energy Use in Virginia by Sector, 2003



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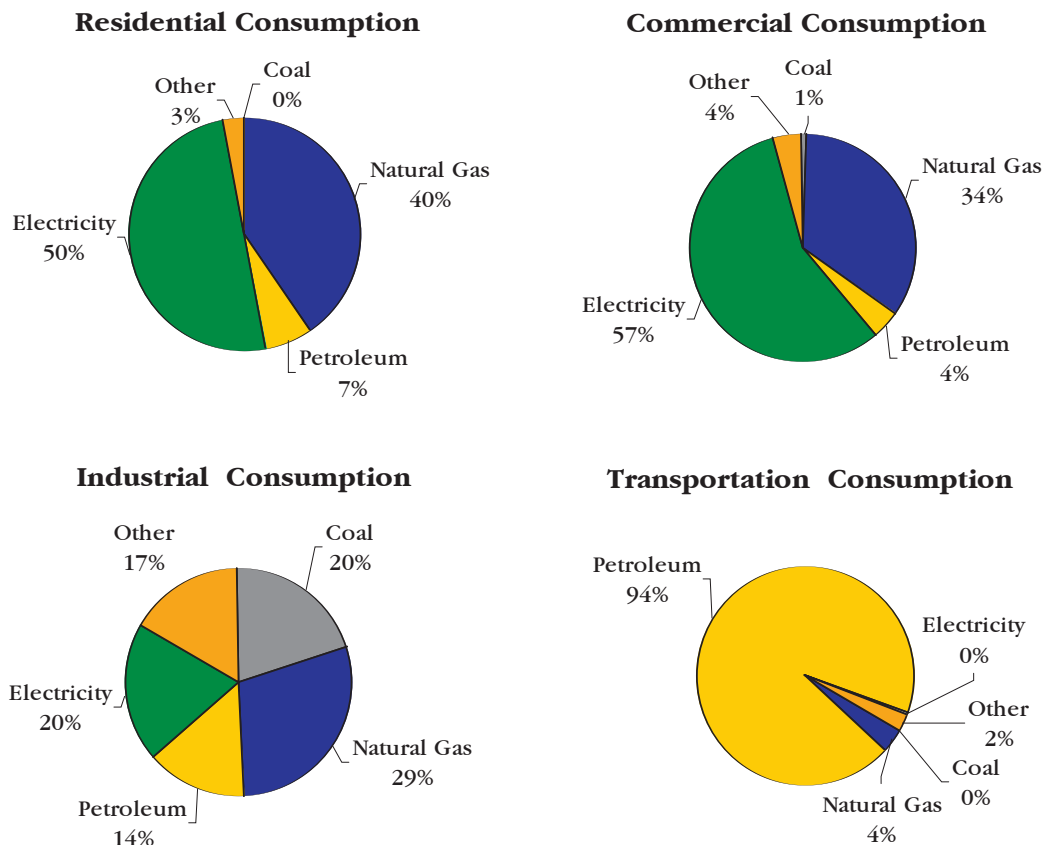
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Virginia's residential consumers rely on electricity and natural gas for 90 percent of non-transportation energy use. Commercial consumers rely on electricity and natural gas for 91 percent of energy use. Industrial consumers rely on a more even distribution of energy types.

Virginia's transportation energy use relies almost completely, at 94 percent of total, on petroleum. Figure 1-3 illustrates the sources of energy used by these four sectors.

Figure 1-3 Sources of energy for residential, commercial, industrial, and transportation consumption



Since the 1970s, energy efficiency and conservation practices have significantly reduced the amount of energy used in the Commonwealth. Despite these actions, energy demand in Virginia has grown steadily over time, as shown in Figure 1-4. This growth generally follows growth

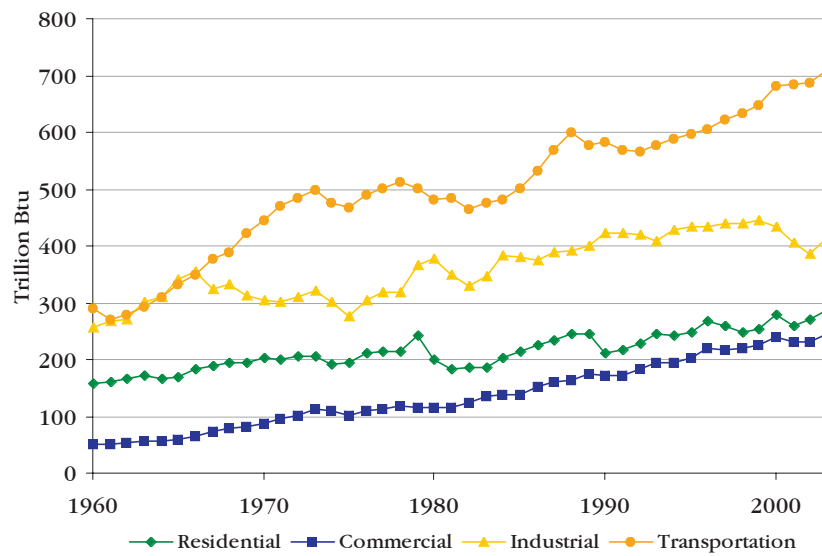
in the state's economy. However, transportation energy use has increased at a faster pace than other sectors as Virginians' vehicle ownership rates and vehicle miles traveled have increased faster than overall economic growth.

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Figure 1-4 Virginia's Energy Use - Growth over Time

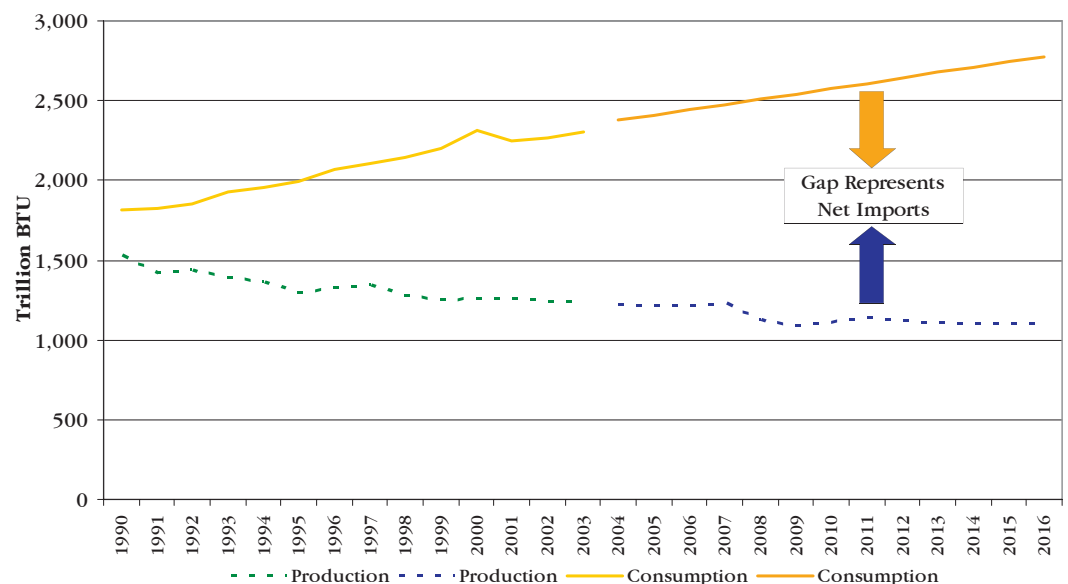


Virginia's growing economy will need increasing amounts of energy over the next ten years. As the state's economy moves to include a greater percentage of service jobs and as more computers, electric appliances, and equipment are placed in use, the state will consume more electricity. Constraints in natural gas production, transmission, and distribution infrastructure, combined with conservation by natural gas users in response to recent price increases, will limit growth in natural gas consumption. Some increase in demand for natural gas will come from

new natural gas-fired electric generation facilities. Increased use of alternate transportation fuels and increased fuel efficiency will reduce the growth rate for petroleum.

Virginia's energy production is expected to decrease over time as the amount of coal mined in Virginia decreases. This will result in a growing gap between what Virginians use and what the state produces (see Figure 1-5) and will increase the drain on Virginia's economy through increased payments for imported energy.

Figure 1-5 Virginia's Supply and Consumption Gap (Trillion BTUs)



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Energy efficiency and conservation provide the least costly and most readily deployable energy resource options available to Virginia.

Virginia will need a broad mix of energy sources over the next ten years. New technologies should expand the state's energy portfolio, including prudent investments in projects such as the Virginia City Hybrid Energy Center's fluidized bed coal power plant, the Integrated Gasification Combined Cycle (IGCC) power plant proposed to serve Appalachian Power customers, liquid fuel production from agricultural and waste products, wind, and solar. New nuclear power generation, hydrogen, methane hydrates, and ocean power are beyond the ten-year scope of this Plan.

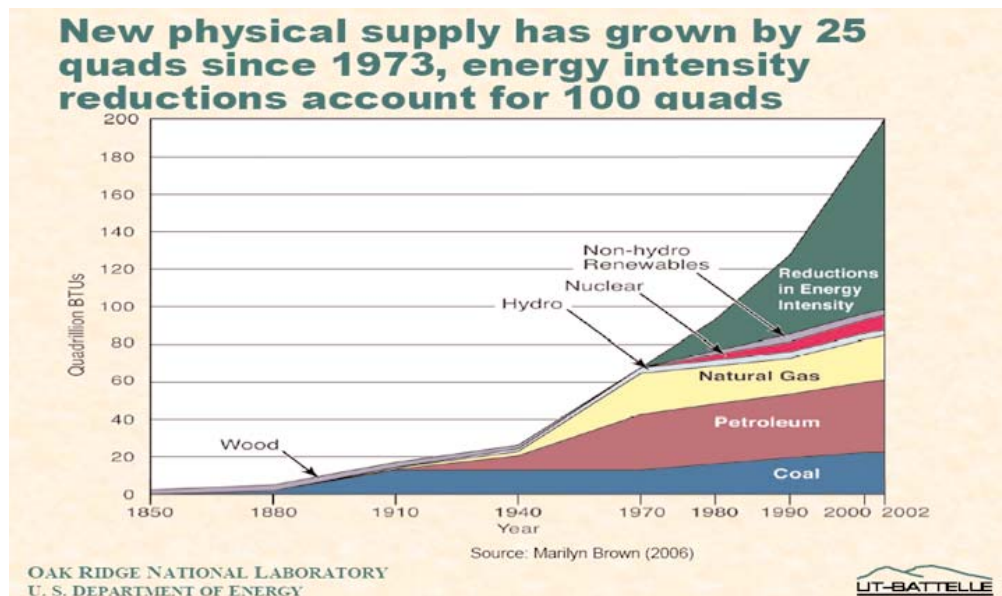
Virginia will need to reduce the energy growth rate through conservation and efficiency and increase its indigenous production of energy, both renewable and conventional, to meet energy growth after efficiency and conservation have been

implemented. Specific goals and recommendations addressing energy resources and consumption are set out in other Plan sections addressing energy efficiency and conservation and infrastructure.

1.1.2 Energy Efficiency and Conservation

Energy efficiency and conservation provide the least costly and most readily deployable energy resource options available to Virginia. As shown in Figure 1-6, analysis by the Oak Ridge National Laboratory shows the United States has made significant strides in energy efficiency and conservation since the 1970s; energy consumption would have doubled without past efficiency and conservation actions.

Figure 1-6 Impact of Energy-Efficiency Efforts on U.S. Energy Intensity, 1973-2002



However, Virginia has invested less in energy efficiency and conservation than some other states and therefore still has significant short and long-term opportunities for efficiency and conservation. Investment has been limited because the relatively low cost of energy has reduced the number of cost-effective options. Utility investments in efficiency and

conservation were also limited by the need to reduce costs as Virginia moved to a competitive utility market.

As energy costs increase, Virginia is in a better position to achieve significant cost-effective energy savings.

Energy efficiency and conservation opportunities can be classified as having technical potential, achievable potential,

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Legislation enacted in 2007 set a goal to reduce 2022 electric use by 10 percent of 2006 retail consumption through conservation and efficiency. Reaching the 10 percent goal would defer or postpone the need for approximately 3,900 megawatts of new electric generation capacity by 2022, equivalent to four or five large generation stations.

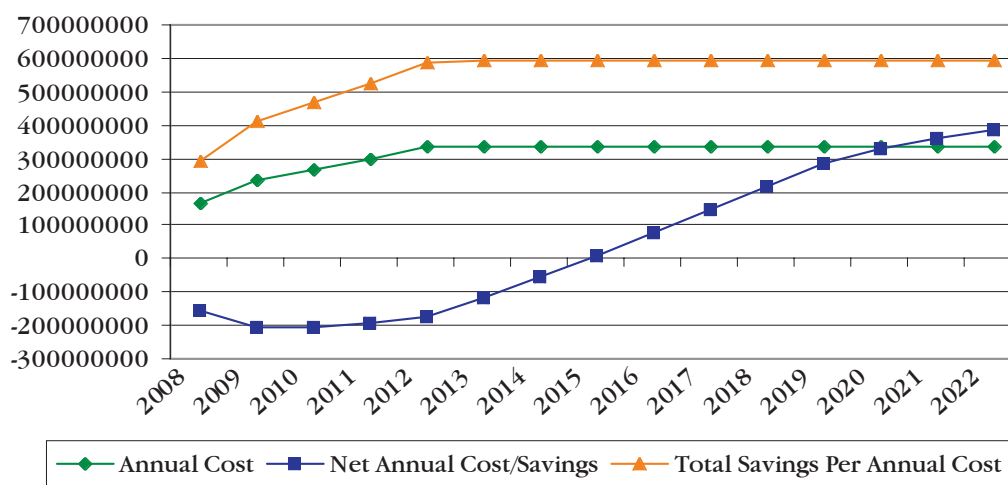
and achievable cost effective potential. Calculations based on studies in other states show that Virginia, with a concerted investment in energy efficiency and conservation activities, has an achievable cost effective electric energy reduction potential of 14 percent over the next ten years.

Legislation enacted in 2007 set a goal to reduce 2022 electric use by 10 percent of 2006 retail consumption through conservation and efficiency. Reaching the 10 percent goal would defer or postpone the need for approximately 3,900 megawatts of new electric generation capacity by 2022, equivalent to four or five large generation stations. Virginia consumers would save in the range of \$200 to \$700 million (net savings after costs) through 2022 (average \$15 to \$50 million per year), depending on the value assigned to electricity savings. Consumers

would receive substantial lifetime savings for their investments in efficiency. Total savings over the lives of the measures would range from \$300 to \$590 million for each yearly investment in energy-efficiency measures (see Figure 1-7).

Achieving these savings would require a substantial up-front investment. Assuming energy-efficiency measures cost three cents per lifetime-kilowatt-hour-saved¹, utilities and consumers together would have to invest an average of approximately \$300 million per year (\$100 to \$120 million by electric utilities, matched by \$180 to \$200 million by consumers) over the fifteen-year life of the program. Consumers as a whole would see a net increase in costs because of the investments in efficiency over the first seven or eight years, followed by net savings over the next seven or eight years.

Figure 1-7 Electric Energy Efficiency Costs and Savings



Similar calculations show that Virginia could realize, with a concerted investment in efficiency and conservation, natural gas savings of approximately 7.5 percent over the next ten years. This would lower Virginian's natural gas costs by an average of approximately \$125 million annually (net savings after program expenses based

on 2007 natural gas costs). A national estimate of fuel oil conservation opportunities found that fuel oil use could be reduced 13 percent by 2015 through an aggressive program of conservation and efficiency.

The state should continue its efforts to ensure that affordable energy is available

¹From the 2006 National Action Plan for Energy Efficiency.

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Reducing transportation fuel use by 5 percent through these measures would save 260 million gallons of gasoline per year, equivalent to the energy used by 300,000 cars in Virginia each year.

to low-income and elderly Virginians. The Weatherization Assistance Program is most effective when it receives a consistent level of financial support from year to year. More households can be served with a reliable source of increased funding. Virginia has provided additional funding to the Low-Income Home Energy Assistance Program in times of sharply increased energy costs or particularly cold winters. This support has helped the Commonwealth's most vulnerable households afford needed heat and electricity.

Transportation efficiency improvements have the potential to reduce state energy use. The state can help build the infrastructure to move more long-distance freight from trucks to rail, improve public transit service, implement additional transportation demand-management activities such as telecommuting, ride-sharing, and car-sharing, increase capacity for alternate transportation modes such as bicycling and walking, implement more congestion-mitigation actions, and modify land-development practices. Virginia's statewide 2007 transportation funding package will provide substantial new funding to advance these efforts. For fiscal years 2008-2013, statewide transportation

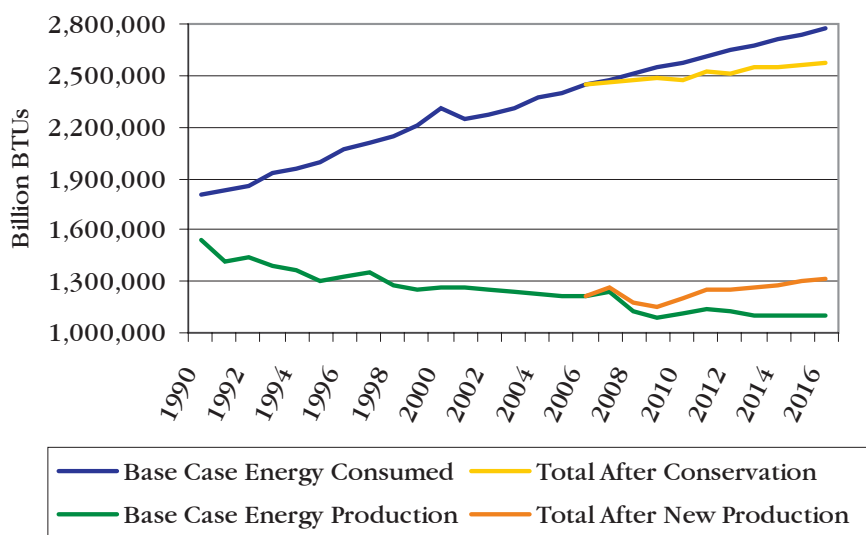
funding will increase 44 percent and rail 40 percent. For public transportation, total funding is around \$2 billion.

Energy-based transportation measures should be targeted at reducing vehicle miles traveled, increasing transportation efficiency, and increasing use of alternate transportation fuels. Reducing transportation fuel use by 5 percent through these measures would save 260 million gallons of gasoline per year, equivalent to the energy used by 300,000 cars in Virginia each year.

New technologies should be available within the term of this Plan to help advance energy efficiency. These may include items such as light-emitting diode (LED) lighting, microgeneration systems, cool roofs, computer network controls, and new automobile technologies.

Increased energy efficiency and conservation and new sources of energy will result in a modification of the supply and demand curves. These supply and demand wedges will reduce the gap between supply and demand and reduce the drain on Virginia's economy from energy imports (see Figure 1-8).

Figure 1-8 Virginia Total Energy Produced and Consumed, 1990-2016



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Changing consumer behavior and creating demand for energy services and products can have the largest impact on our ability to meet our energy goals.

Goals for Energy Efficiency and Conservation

Reduce by 40 percent the rate of growth in energy use that it would see without the Plan's recommended efficiency and conservation actions. This would reverse the growth in per capita energy use and result, by 2017, in a nearly level per capita energy use per year. Meeting this goal will require a concerted effort in implementing new actions to reduce electric, natural gas, and petroleum product use. This goal also includes weatherizing an additional 700-plus homes of Virginia's low-income families per year through increased investment in the Weatherization Assistance Program.

Increase consumer education about energy use and conservation.

Consumers must be educated about energy opportunities if we are to overcome the consumer knowledge market barriers. With clear knowledge, consumers will be comfortable in taking energy-saving actions and making energy-savings investments. Changing consumer behavior and creating demand for energy services and products can have the largest impact on our ability to meet our energy goals.

Recommendations for Energy Efficiency and Conservation

Government policy can support increased use of energy-efficiency and conservation measures and help ensure that energy suppliers can provide needed infrastructure. State, federal, and local governments each have a role in setting energy policy.

Recommendation: Virginia should increase incentives for consumer energy efficiency by expanding tax benefits for consumer investments. Virginia, contingent on an acceptable revenue impact, should:

- Expand its sales-tax holiday to high-

efficiency natural gas, fuel oil, and propane equipment.

- Add a spring sales-tax holiday weekend for Energy Star equipment to provide an incentive for high-efficiency air conditioning and other equipment not covered in the fall Energy Star sales-tax holiday.
- Provide tax incentives for energy efficiency and conservation similar to those provided by the federal government for investments such as energy-efficiency building improvements, high-efficiency equipment, combined heat and power installations, heat recovery, and other technologies.

Recommendation: Virginia's utilities should sponsor or offer efficiency and conservation programs for their customers.

- Subject to the outcome of the 2007 State Corporation Commission energy conservation and demand-control study, the Commonwealth, in cooperation with electric utilities and energy-efficiency service providers, should initiate an aggressive set of actions to expand use of energy efficiency, conservation, and demand management to offset electric demand and use. Energy-efficiency and conservation activities, or program portfolios, should address all customer classes and income levels.
- Any portfolio of electric energy conservation activities should be evaluated for cost effectiveness. Virginia should use a mix of the Total Resource Cost Test, Societal Test, Utility/Program Administrator Test, Participant Test, and Rate Impact Measure Test. No one single tool should be used solely as a go-no go decision mechanism.
- These activities will require incentives to overcome implementation barriers. Based on incentives provided in other states' successful programs, Virginia's electric utilities would have to invest \$116 million

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per year to reach the 10 percent electric savings goal.

- Energy conservation and demand-control activities should be evaluated for effectiveness through use of measurement and verification protocols. Programs not meeting planned results should be reevaluated to determine if they should be modified or ended.
- Virginia should carefully implement a combination of natural gas local distribution utility revenue decoupling for energy-efficiency and conservation programs.
- Virginia's natural gas utilities and producers also should broadly implement the U.S. Environmental Protection Agency's Natural Gas Star recommendations to conserve natural gas and reduce leakage in production, transmission, and distribution operations.

Recommendation: *Virginia should expand support for programs that help low-income Virginians reduce their energy use.*

- Virginia should expand the capacity of and funding for the Weatherization Assistance Program to allow additional low-income households to receive energy-efficiency and conservation improvements. Two million dollars per year would allow the program to serve an additional 715 households per year. The weatherization work reduces these households' energy bills and their need for other energy assistance.
- Virginia should provide additional funding to the Low-Income Home Energy Assistance Program in times of sharply increased energy costs or particularly cold winters.

Recommendation: *Virginia should implement an expanded energy education program.* This program should be developed by July 2008 based on input from energy and education stakeholders.

- Virginia should implement an energy-conservation consumer-education program to overcome consumer market barriers and allow consumers to be confident in investing in energy-efficiency and conservation improvements. Education efforts should be included as part of utility energy-efficiency and conservation programs. Education efforts should include more widely promoting web-based education resources such as the *Virginia Energy Savers Handbook* to consumers.
- A broad energy-efficiency/green-product-branding effort is needed to provide consumers with a reliable label on energy-using products and energy-efficient materials. One choice is to expand the federal Energy Star designation to all types of energy-using equipment and energy-savings materials. If the federal Energy Star cannot be expanded, then Virginia should support implementation of an independent energy-efficiency label program. This effort should be coordinated with utilities and retail-store communication programs.
- Energy education should include information to help consumers avoid fraudulent claims of energy savings. This should be provided in cooperation with the Office of Consumer Affairs at the Department of Agriculture and Consumer Services.
- Virginia should promote use of educational resources available in federal programs such as Clean Cities, Rebuild America, Climate Leaders, and the U.S. Mayors Climate Protection Agreement (Cool Cities) and Cool Counties.
- Virginia should continue to actively promote recycling.
- An effective, statewide non-utility energy-education program will require \$1 million per year to support development and delivery of energy information to consumers.

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This consumer-education work would be in addition to, and coordinated with, energy education included in utility-sponsored efficiency and conservation programs.

Recommendation: *Virginia should implement policies to improve the energy efficiency of its building stock.*

- Virginia should ensure that the energy requirements in the Uniform Statewide Building Code result in the most efficient energy performance that is cost effective. This may require use of energy codes more stringent than those in the model International Building Code.
- Virginia should provide training to building code officials, architects and engineers, and the building community on how to properly meet energy codes and use more energy efficient building standards.
- Virginia should work with its building community to provide additional energy-conservation education to the industry's workforce.
- Virginia should initiate a home energy rating system for new and existing homes.

Recommendation: *Virginia should support efforts by its industrial and commercial sectors to improve the efficiency of their operations.*

- Virginia should establish energy assessment centers, similar to federally funded industrial energy assessment centers, at its engineering universities or with other providers, to offer energy audits and assessments to small commercial and industrial consumers.
- Virginia should help industrial consumers implement waste-to-energy, heat recovery, and combined heat and power projects.

Recommendation: *Virginia should support deployment of new energy-conservation technologies.*

- Virginia should monitor new technology development and provide financial support to encourage early adoption of emerging energy technologies.

Recommendation: *The federal government should expand its efforts in support of energy efficiency and conservation.*

The federal government has a primary role in promoting energy efficiency and development of reliable energy supplies through tax policy and direct financial assistance, research and development, energy data publication, equipment and vehicle standards, and public education. Many of these policies must be implemented on a national or regional basis, as state implementation would introduce dysfunction into markets or lead to duplication and inefficiencies.

- The federal government should continue providing the numerous energy-efficiency and conservation, research and development, energy data, grants, and other services to residential, commercial, industrial, and institutional consumers.
- The federal government should increase its investment in energy efficiency and conservation and alternate energy development, and support state efforts to deliver these services to consumers. These investments should be provided at a stable level over a multiyear period to ensure that partners can efficiently plan and implement new investments.
- The federal government should more broadly implement improved appliance efficiency requirements. If neighboring states set higher appliance standards, Virginia should consider joining them to set a regional appliance efficiency standard in the common market areas.

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Corporate Average Fuel Efficiency (CAFE) standards for vehicles should be increased 10 miles per gallon over the next ten years to 37.5 miles per gallon for automobiles and 32.2 miles per gallon for light trucks.

- Corporate Average Fuel Efficiency (CAFE) standards for vehicles should be increased 10 miles per gallon over the next ten years to 37.5 miles per gallon for automobiles and 32.2 miles per gallon for light trucks, with off-ramps for proven technical or safety roadblocks. CAFE standards should be based on actual mileage and should not be adjusted upward based on use of alternate fuels in fleets. CAFE protocols should be periodically adjusted to account for changing driving conditions such as urban/suburban/rural driving patterns, typical congestion delays, and typical speeds driven.

Recommendation: *Local governments should establish policies to increase the energy efficiency of their citizens.*

A number of early-adopting Virginia localities are taking action to encourage energy-efficiency and conservation action by their citizens. Other Virginia localities should follow their lead and establish policies to encourage additional private energy conservation actions.

- Localities should take advantage of authority granted under 2007 legislation to create a separate real-estate classification and lower tax rate for buildings that are 30 percent more efficient than required by building code.
- Localities should adopt land-use plans that allow higher-density development near mass transit nodes and encourage mixed-use communities, urban redevelopment, and infill development.
- Localities should allow higher-density development for projects meeting Leadership in Energy and Environmental Design (LEED) standards, and streamline permitting and reduce permitting fees for LEED buildings.
- Localities should consider how development and transportation

patterns affect energy use when developing their comprehensive plans.

- Localities should assess the use of conservation easements and purchase of development rights as a way to preserve open space and direct development toward areas with mass transportation available.
- Localities should take advantage of authority granted under 2007 legislation to enter into agreements with nonpublic schools to provide student transportation, increasing the efficiency of the overall student transportation system.
- Localities should support development of new renewable energy and distributed energy applications. Localities should use the Virginia Renewable Site Scoring system developed under authority of the Virginia Energy Plan legislation in their local land-use decision-making process.
- Localities should consider sharing landfill tipping fees with projects that convert waste to energy and in turn reduce waste volume and extend the life of the locality's landfill.

Each Virginian affects the state's energy future through day-to-day and long-term lifestyle decisions. There are many easy, small decisions that collectively can make a big difference in energy use. These decisions should be made wisely so that adequate supplies will be available to meet Virginia's future needs. These decisions can be made by Virginia's governments, individuals, and businesses.

Recommendation: *Government should lead by example and implement all cost-effective conservation opportunities.*

- State government has completed an operational review of energy use to identify other opportunities for energy management and efficiency

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Each Virginian affects the state's energy future through day-to-day and long-term lifestyle decisions. There are many easy, small decisions that collectively can make a big difference in energy use.

improvements. State government should implement the actions under Executive Order 48 (2007) and the best practices identified during the operational review to reduce energy use and costs.

- Federal government agencies have taken many actions in Virginia to reduce their energy use and use alternate supplies of energy. The Federal Energy Management Program is a model for an organization's energy management practices. Virginia should pursue opportunities to work together with federal facilities on energy management, through the Virginia Regional Environmental Management System.
- Numerous Virginia localities have taken actions to manage their energy use. All Virginia localities should follow the lead of these local governments and implement cost-effective internal energy-conservation opportunities and establish policies to encourage private energy conservation actions.

Recommendation: *Individual consumers should make day-to-day and long-term lifestyle choices that save energy.*

- Virginians should take the many simple, daily lifestyle steps to use energy more efficiently, such as using compact fluorescent light-bulbs, ensuring that heating and cooling equipment is properly serviced, lowering water-heater temperature settings, adding insulation to water heaters and pipes located in unheated areas, sealing leaks in homes, turning lights and equipment off when not needed, not overcooling or overheating homes, planning trips, and not driving at excessive speeds. These small steps can add up to big savings.
- Virginians should consider the energy impacts of broader lifestyle decisions such as where to live or what forms of transportation to use.

They also can choose to build more efficient houses that meet Energy Star or EarthCraft Home standards. A small initial investment in increasing the energy efficiency of new homes will be returned in lower energy bills, reducing the overall cost of ownership and increasing housing affordability.

- Consumers should reduce energy use and costs through purchasing decisions. For example, Virginians can save considerable energy by purchasing Energy Star and other high-efficiency equipment whenever available.
- Virginians should make fuel efficiency a primary factor in vehicle purchase decisions. All drivers should keep vehicles properly maintained, such as keeping tire pressure at recommended levels and keeping vehicles tuned up.
- Consumers should take actions that, while not saving energy directly, have an indirect effect on energy consumption. This includes actions such as purchasing goods with less extensive packaging and recycling.

For more information on how individuals can use energy wisely, see the *Virginia Energy Savers Handbook* and other consumer information at www.dme.virginia.gov/DE/ConsumerInfo/consumerinfo.shtml or the U.S. Department of Energy's *Consumer Guide to Energy Efficiency and Renewable Energy* at www.eere.energy.gov/consumer.

Recommendation: *Commercial businesses should give priority to energy-efficiency and conservation actions.*

Just as individual consumers can affect our energy future, commercial businesses can increase the efficiency of energy use in Virginia.

Energy Management

- Commercial businesses should use best energy management practices such as those in the Energy Star or

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Just as individual consumers can affect our energy future, commercial businesses can increase the efficiency of energy use in Virginia.

Energy is the second largest cost after personnel for many industries. Energy cost savings usually improve a company's bottom line.

ANSI/MSE 2000:2005 protocols.

- Commercial businesses should participate in Virginia's Environmental Excellence Program.

Commercial Buildings

- Commercial businesses have a long-term impact on energy use through their design and construction decisions. Constructing high-efficiency buildings, such as those that meet the energy standards for LEED buildings, provides long-term energy and environmental savings. Constructing a LEED building can increase first costs by 2 to 3 percent, but the investment will be returned through lower operating costs in as little as four years.
- Commercial business managers should give priority to energy efficiency when renting space.
- Commercial business owners should invest in all cost-effective efficiency and conservation improvements, or use energy savings performance contractors to implement energy savings improvements.
- Commercial property that has not had a rigorous preventative maintenance program should be recommissioned (like a building tune-up) if the building has been in operation for more than ten years. Commercial businesses should also ensure that new buildings, whether self-built or leased, have been properly commissioned to reduce ongoing energy use and costs.
- Commercial businesses should purchase high-efficiency Energy Star or equivalent equipment.
- Lighting is critical to most retail businesses. Retail businesses should maximize use of daylight to reduce daytime electrical lighting and select the most efficient sources of lighting that provide proper color control for their business needs.

Recommendation: *Virginia's manufacturers should give priority to energy-efficiency and conservation actions.*

While Virginia's manufacturers have taken many actions to reduce their energy expenditures, many energy-conservation opportunities are still available. Energy is the second largest cost after personnel for many industries. Energy cost savings usually improve a company's bottom line.

Energy Management

- Industrial concerns should follow best energy management practices provided for in the Energy Star or ANSI/MSE 2000:2005 protocols.
- Virginia's industries should avail themselves of energy-conservation tools through the Federal Department of Energy's Industrial Technologies Program

Process Efficiency

- Small manufacturers should use the services of industrial assessment centers to identify and implement cost-effective energy-efficiency process improvements.
- Larger industrial operations should pursue cost-effective opportunities through the federal Industrial Technologies Program for such things as process improvements, use of variable-speed motor drives, development of combined heat and power, waste heat recovery, and waste-to-energy applications.

Recommendation: *Agricultural and forestry operations should expand use of energy-efficiency and conservation actions.*

There are many practices that Virginia's agricultural and forestry industries can implement to improve energy efficiency and conservation.

- Virginia's forest products industry should follow the practices set out in the Forest Products Industry of the Future program.

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Three paths should be followed to reduce the energy impact of transportation in Virginia: reduce vehicle miles traveled, increase the efficiency of our vehicles and fleets, and replace imported petroleum with renewable liquid fuels.

- Virginia's farms and agribusinesses should use the energy management tools provided by the U.S. Department of Agriculture and National Resources Conservation Service.

Recommendation: *Virginians should increase the energy efficiency of fleets and transportation systems.*

Three paths should be followed to reduce the energy impact of transportation in Virginia: reduce vehicle miles traveled, increase the efficiency of our vehicles and fleets, and replace imported petroleum with renewable liquid fuels.

Reducing Vehicle Miles Traveled

- State and local governments should better integrate land-use and transportation planning. State agencies addressing transportation and energy should monitor performance measures for per capita transportation energy use and vehicle miles traveled as a measure of transportation energy efficiency.
- Virginia should fully implement its portfolio of transportation demand management tools, including providing capital and operating funding to create easy-to-use alternatives to single-occupant vehicle commutes and access to reasonably priced and regularly scheduled mass transit service in both urban and suburban areas.
- Virginia should give priority to congestion-mitigation projects when allocating transportation funding.
- Virginia should continue to support development of new light rail systems in urban areas, such as the proposed Norfolk Light Rail project.
- Virginia should continue to develop its transportation infrastructure to include facilities for no- or low-fuel methods such as walking, bicycling, and small scooters consistent with the Commonwealth Transportation Board's *Policy for Integrating Bicycle and Pedestrian Accommodations*.

- Virginia should review its roadway design standards to evaluate whether changes can be made to facilitate higher-density development in urban areas.
- Virginia state and local policies should encourage land-use patterns that allow for construction of safe and accessible facilities for non-motorized transportation and that reduce the need for long commutes.
- Virginia should continue to expand the availability and use of high-occupancy vehicle (HOV) and high-occupancy tolling (HOT) lanes through expansion of service on I-95, adding HOV/HOT lanes to the Washington, D.C., Beltway, and on other highways as congestion increases.
- The Commonwealth should increase its work to promote the use of alternate methods to single-occupant commutes such as telecommuting, ride-sharing, and car-sharing through consumer education, providing telecommuting centers, and providing convenient locations for car-share parking.
- Virginia should make a concerted effort to move truck freight to rail and barge.

Increasing Fleet Efficiencies

- Individuals and businesses should include fuel efficiency in their decision making when purchasing vehicles and equipment.
- Fleet operators should plan vehicle routes to minimize mileage and minimize travel during highly congested times.
- Vehicle owners should keep vehicles properly maintained, such as keeping tire pressure at recommended levels and keeping vehicles tuned up.
- Virginia has recently restricted use of newly purchased hybrid vehicles in HOV lanes. Use of highly fuel efficient hybrids in HOV lanes can balance the goals of mitigating

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Driving smart saves fuel. Using controlled acceleration and deceleration, cruise control, and slowing down can significantly increase fuel efficiencies. Tests of aggressive versus calm driving in cities show up to 25 percent savings using best driving practices. For every 5-mph decrease on the highway, a typical driver will save 5 percent in fuel.

congestion and reducing energy use in transportation. The Commonwealth should evaluate the effect this has on the rate of hybrid vehicle market penetration. If the market penetration rate declines in relation to other states, Virginia should work with the federal government to reconsider the ban for the most fuel-efficient hybrid vehicles. For example, any hybrid with a more than 50-mpg combined mileage rating could still be allowed to obtain clean special vehicle license plates and use the HOV lanes.

- Driving smart saves fuel. Using controlled acceleration and deceleration, cruise control, and slowing down can significantly increase fuel efficiencies. Tests of aggressive versus calm driving in cities show up to 25 percent savings using best driving practices. For every 5-mph decrease on the highway, a typical driver will save 5 percent in fuel.

Using Alternate Transportation Fuels

- The biofuels incentive program should be adequately funded. The Virginia Economic Development Partnership, Department of Agriculture and Consumer Services, and Department of Mines, Minerals and Energy should continue to work with prospective companies to increase the amount of alternate transportation fuels produced in Virginia.
- Virginia should consider mandating use of 10 percent ethanol and 5 percent biodiesel in all retail fuel sales when there are sufficient supplies available from non-food crop sources to support this use. Any mandate should be coupled with incentives for fuel terminals to make the necessary infrastructure improvements to handle the new fuel mixes.
- Virginia should amend its statute and regulations to allow for

flexibility in blending conventional and alternate fuels to facilitate increased alternate fuel sales. For example, repealing the ethanol content pump labeling requirements would provide gas-station owners with increased flexibility to sell conventional or reformulated gasoline in areas where reformulated gasoline is not required.

- Virginia should help increase the market availability of E85 and B20 or greater biodiesel by helping retailers add new retail outlets for the fuels.
- The Commonwealth should, consistent with Virginia's hydrogen blueprint, carefully monitor the potential for hydrogen technologies to serve Virginia's energy needs.

Recommendation: *Virginia's higher education institutions should expand efforts to use energy wisely and train the next generation of leaders about energy.*

Virginia's higher education institutions can lead by example by implementing energy-efficiency and conservation actions across their campuses. These actions will not only reduce energy use and lower energy bills but will also help educate future generations of leaders on how to make wise energy decisions.

- Virginia universities should expand involvement in the Greening the College Campus or similar activities to increase energy efficiency of their operations.

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Virginia will need to add energy infrastructure over the next ten years to continue to provide reliable, low-cost energy to its consumers and decrease the potential risk consumers face from disruptions in energy supplies.

1.1.3 Virginia's Energy Infrastructure

Virginia is home to significant electric generation and transmission, natural gas and petroleum pipeline and storage, rail and road, and marine import infrastructure (see Figure 1-9). The state is also home to one medium-sized petroleum refinery.

Virginia will need to add energy infrastructure over the next ten years to continue to provide reliable, low-cost energy to its consumers and decrease the potential risk consumers face from disruptions in energy supplies.

Figure 1-9 Virginia's Energy Infrastructure



Electric Infrastructure

Virginia is at the southern end of the Mid-Atlantic area which is projected to violate electric reliability standards as early as 2011. With no increase in conservation, Virginia would need to add an additional 5,098 megawatts of capacity through a mix of electric generation or imports coupled with increased transmission capacity. If the 10 percent energy-efficiency and conservation goal set in 2007 legislation is met, the state would still need to add an additional 2,358 megawatts of capacity. Additional electrical infrastructure growth will be needed if any current capacity must be retired. This capacity will need to serve electric growth in the northern Virginia, Hampton Roads, and central Virginia areas.

Natural Gas Infrastructure

Virginia will need new onshore natural gas infrastructure over the next ten years. Virginia is near the end of the natural gas pipelines that bring Gulf of Mexico gas to markets. The state relies on these main transmission pipelines and shorter branch lines to deliver natural gas to users throughout the state.

The highest-priority need for new natural gas infrastructure is a third natural gas pipeline crossing the James River. Other transmission and distribution pipeline projects will be needed to solve local reliability problems and serve new large users such as electric generation plants.

Virginia's natural gas utilities will also need to add additional storage to their systems to meet peak winter and summer demands for natural gas.

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The state is an attractive expansion target for liquefied natural gas (LNG) imports. Virginia's utilities would need to add new pipeline transmission capacity if any LNG import facility is located in the state.

Virginia's natural gas producers will continue to need new gathering pipeline and compression capacity to serve new areas where natural gas wells are drilled. These will be needed to serve both expanded coalbed methane production as well as new wells producing from deep shale formations.

Petroleum Infrastructure

The state's petroleum infrastructure will need to adapt over the next ten years to accommodate growth in alternate transportation fuels. New fuels require additional tanks and handling facilities at terminals. Virginia will need to add or retrofit a significant number of retail outlets for E85 and biodiesel fuels. New alternate fuel producers require land, buildings, and rail and road access. Expansion of the petroleum refinery in Yorktown would enhance Virginia's ability to supply reliable gasoline and diesel supplies to end users.

Virginians need to learn more about the extent to which offshore natural gas and petroleum deposits exist before making any final decision regarding offshore production. Current state policy supports natural gas exploration more than 50 miles from the coast. The federal government should work with the offshore oil and natural gas industry to develop geophysical information about the offshore geology and possible deposits. Virginia, working with the federal government and the offshore industry, needs to continue research on the offshore environment, including marine and seafloor life, ground stability, and other relevant matters.

The Minerals Management Service should also revise its offshore administrative boundaries using a more equitable method that does not allocate large areas to states with convex coastlines and small areas to states with concave-shaped coasts.

Renewable Energy Infrastructure

Virginia will need new infrastructure to support its renewable fuels industry. There are limits under Virginia's renewable portfolio standard to the amount of wood that can be used for biomass-based electric generation. There also are limited supplies available for large cellulosic liquid fuel projects. Therefore, Virginia needs to develop new infrastructure for biomass energy use, including facilities to gather, process, and store wood from sources such as land clearing, urban wood waste, and wood residue left after logging.

There may also be a need for additional electrical distribution or transmission lines to serve new alternate electricity generation. This may include onshore wind-powered projects as well as offshore wind- and ocean-powered generation.

Coal Infrastructure

Virginia relies on railroad and highway infrastructure to transport its coal resources. Coal is processed at preparation plants located in Virginia's coalfields. This infrastructure should not need major improvements over the ten-year term of this Plan. There will be a need for new coal haulage roads and public road improvements as mines open and close in order to minimize conflict between routes needed to haul coal and built-up communities. The state's electric consumers would benefit from adding import capacity at one or more coal export facilities along Virginia's coast. This would allow for an increase in competition for coal supplied to electric utilities and would help mitigate future price increases.

Nuclear Infrastructure

New nuclear energy production is not expected to come on-line over the ten-year term of this Plan. However, a new nuclear power plant may be under construction during the term of this Plan and come on-line shortly thereafter.

Although production of uranium is prohibited under state law and legislative action would be needed to lift this

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moratorium, uranium exploration activities are expected during the term of this Plan. This is in response to the long-term price increases for uranium and the need to supply future new nuclear reactors around the world. Virginia should take steps during the term of this Plan to understand the environmental risks and identify controls needed if uranium mining were to be allowed.

Goals for Energy Infrastructure and Supply

Increase in-state production of energy by 20 percent over what is projected in 2017. To meet this goal, Virginia will need expanded electrical, natural gas, and liquid fuel resources.

- Even after meeting the 10 percent electric savings goal set out in 2007 legislation, Virginia will need to expand its electric generation infrastructure by more than 2,300 megawatts. This new generation will need to be supplied through both conventional and renewable generation. Virginia electric utilities will also need to construct new transmission infrastructure to deliver electricity to growing market areas.
- Virginia's natural gas utilities will need to make ongoing investments in new infrastructure to deliver natural gas to consumers. This includes constructing a third pipeline across the James River between north and south Hampton Roads and constructing new local distribution pipelines and peak storage facilities. Additional upstream natural gas infrastructure is also needed to bring adequate natural gas supplies to Virginia's natural gas consumers.
- Virginia will need to invest in new liquid fuel infrastructure. The energy generation goals in this Plan include increasing the capacity of the petroleum refinery in Yorktown

by 40,000 barrels per day and providing 300 million gallons per year of ethanol production and 120 million gallons per year of biodiesel production. This would offset imports needed to fuel 1.2 million of the state's cars and trucks per year.

The General Assembly enacted renewable energy grant programs established in 2006 legislation. Virginia must fund these grants and other efforts to expand use of renewable energy sources if there is to be a significant growth in renewable energy use over the life of this Plan. These efforts will allow renewable energy sources to become self-sustaining in the future.

Recommendations to Improve Virginia's Energy Infrastructure and Supply

Virginia must ensure that there is adequate infrastructure to provide needed energy supplies to Virginia. Adding infrastructure will help decrease energy imports. This will keep funds otherwise spent on energy imports in Virginia's economy and decrease the potential risk consumers face from disruptions to energy supplies.

Recommendation: *Virginia should support expansion of the state's electric infrastructure needed for the state's growing economy.*

- Virginia's electric utilities should provide sufficient information with their biennial filings to facilitate a wider public understanding of the Commonwealth's future electric demands and plans to meet these demands.
- Developers of conventional electric generation capacity that would serve and be paid for by Virginia electric consumers should be required to show, as part of an application for a Certificate of Public Convenience and Necessity,

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that the conventional generation is needed after all cost-effective energy-efficiency and conservation actions have been implemented, and that the conventional generation is less expensive than new renewable generation capacity.

- Virginia should maintain public policies to ensure that the state's electric utilities have access to low-cost capital for prudent investments in needed new generation capacity such as for the Virginia City Hybrid Energy Center, Virginia's share of new coal-fired Integrated Gasification Combined Cycle power plants, and renewable electric generation.
- Virginia should support development of new electrical transmission facilities to serve growing regions of the state, particularly in northern Virginia and Hampton Roads.
- Virginia will continue to need new and upgraded electric distribution systems. This will require an ongoing investment by Virginia's electric utilities to meet growing system needs and ensure reliability of supply.
- Utility companies should take full advantage of the pre-application planning process established by legislation in 2007 to ensure timely review of electric transmission line applications. The applying utility should make complete information available to the public about the need for the line, including options for not building the line, and for possible routes. The decision-making process on the need for new electric infrastructure should also include opportunity for public involvement early in the process.
- Decisions regarding the routing of electric transmission lines should continue to be made at the state level. There should be no federal designation of a National Interest Electric Transmission Corridor in Virginia. If such a corridor designation is made, the prohibition against use

of federal eminent domain over state property must include a prohibition against use of federal eminent domain to overturn state-owned conservation easements.

- Virginia should develop a better-coordinated approach among the State Corporation Commission (SCC), Office of the Attorney General, the Governor's energy advisor, and environmental agencies to provide state input into the PJM planning process. The level of coordination or communication among the SCC, Office of the Attorney General, and Governor's Office should recognize that the SCC's role may be limited by the need to avoid prejudging matters that may come before it for approval. The Commonwealth also should actively track the North American Electric Reliability Council's planning process for its effect on the state's electric service requirements.
- PJM should include a broad portfolio of conservation and demand-control programs when assessing future loads.
- The Commonwealth, through the Joint Commission on Technology and Science, should continue its evaluation of the costs and benefits of placing electric transmission lines underground in order to generate accurate information needed to determine when the costs of placing lines underground as compared to aboveground make such construction in the public interest.

Recommendation: *Virginia should encourage generation of electricity from new renewable sources.*

- Virginia should develop the supply systems needed to allow wood remaining after commercial lumber harvesting, land-clearing debris, and demolition waste to be used as a fuel source for biomass-fired electric generation plants.

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The Commonwealth should encourage all cost-effective, environmentally responsible development of offshore wind resources.

- The Virginia Tech/Department of Forestry biomass GIS mapping tools should be expanded to include all potential sources of biomass for energy generation.
- Virginia should support expansion of and development of new waste-to-energy facilities to reduce the need for landfills, reduce environmental impacts of managing animal wastes, and meet growing demands for energy. Localities should consider dedicating a portion of tipping fees to support projects that extend the life of landfills. The state should work with localities to pre-package waste-to-energy and alternate fuel production sites with required zoning, environmental assessments, and infrastructure.
- Community associations should not place unreasonable restrictions on renewable-energy installations such as solar thermal or photovoltaic panels that are integrated into the facility design. Community associations and localities are encouraged to consider the results of the state system to rate a property's suitability for solar and wind development when considering approval of such uses.
- Onshore wind should be developed after receiving local land-use approval and a finding that avian and bat species and critical habitat would not be materially affected. Early projects should include post-construction testing to identify avian and bat impact.
- The Commonwealth should fund the Photovoltaic, Solar, and Wind Energy Utilization Grant and Renewable Electricity Production Grant Programs that were established in the 2006 Virginia Energy Plan legislation. Five million dollars per year is needed over the next five years to generate significant private investments in and installation of new renewable energy systems. To the extent that limited funds are available, they should support the

Photovoltaic, Solar, and Wind Energy Utilization Grant Program first. Commercial-scale projects that would be supported by the Renewable Electricity Production Grant Program will be supported under the state's new renewable portfolio standard.

- The Commonwealth should encourage all cost-effective, environmentally responsible development of offshore wind resources. Virginia should work through the Virginia Coastal Energy Research Consortium with the federal Minerals Management Service's Outer Continental Shelf Alternate Energy and Alternate Use Program to more carefully characterize the offshore wind potential and identify potential environmental impacts of such development.

Recommendation: *Virginia should support expansion of the state's natural gas infrastructure needed to support the state's growing economy.*

- Virginia needs to strengthen its natural gas infrastructure by increasing delivery capacity to the south Hampton Roads area and to areas with new development. This will require both new pipeline and peak storage capacity. State, regional, and local economic development and energy officials should monitor the supplies and demand for natural gas and work with natural gas utilities, pipeline companies, and the State Corporation Commission to ensure that an adequate supply infrastructure is available. Provision of adequate infrastructure may require use of alternate rate plans to ensure that consumers pay fair rates and utilities receive adequate return to provide and maintain the needed infrastructure.
- Local distribution companies should work with localities to designate corridors for natural gas pipelines in advance of need and

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avoid conflicts between line extension and local land-use plans.

- Virginia should support projects to diversify natural gas supplies, such as new LNG terminal construction or increased pipeline capacity from southwest Virginia's natural gas fields or other supply areas, to growing areas of Virginia. Such projects should be protective of public safety and high-value environmental resources.
- Any development of offshore natural gas resources should be made consistent with Virginia policy. Both the federal Mineral Management Service (MMS), through leasing actions, and the National Oceanographic and Atmospheric Administration, through the Coastal Zone Management program approvals, should recognize Virginia policy when taking action affecting offshore development. The MMS also should work with the offshore exploration and production industry and East Coast states to determine the extent of offshore natural gas resources and the environmental protections that would be needed if such development were to proceed.

Recommendation: *Virginia should support the petroleum infrastructure needed to supply petroleum and alternate transportation fuel products to Virginia consumers.*

- State and regional economic development entities should continue to work with the Yorktown petroleum refinery owner to support expansion of the refinery.
- As the marketplace for petroleum products expands to include new products such as low-sulfur fuels and non-petroleum alternate fuels such as ethanol and biodiesel, petroleum terminals must reconfigure their facilities to manage the new products. Local governments should, consistent with public health and safety protection needs,

streamline approval of modification plans and provide all available flexibility to terminal operators to make these needed changes.

- Development of alternate fuels such as ethanol and biodiesel will require developing new fuel production and transportation facilities. Other infrastructure will be needed to supply raw-material inputs, such as biomass supplies, to production facilities. Virginia's production incentive for in-state-produced biofuels should be adequately funded. Localities are encouraged to work with state economic development, agriculture, and energy agencies to identify sites providing the necessary infrastructure for new biofuel production facilities.
- Virginia should provide incentives to increase the use of municipal solid waste or agricultural waste for energy generation or alternative liquid fuels.
- Virginia should target the military ground transportation and ship transportation systems as a market for in-state-produced synthetic diesel fuels.
- Any development of offshore petroleum resources should be managed consistent with Virginia policy. No exploration or production of petroleum should be allowed at this time. The federal MMS should work with Virginia, other East Coast states, and the offshore exploration and production industry to evaluate the increased risk and protections that would be needed as part of any leasing of outer continental shelf petroleum deposits.

Recommendation: *Virginia should ensure that its coal industry can provide needed fuel to provide cost-effective electric supplies and energy for the country's steel industry.*

- The Commonwealth and its coal industry should work together to

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maintain a viable mining industry that supports the economy in southwest Virginia and provides needed coal resources for electric and steel production at reasonable costs to consumers. This includes maintaining safe conditions for mine workers (e.g., working to implement changes in federal mine safety law related to mine rescue, emergency supplies in mines, underground miner tracking and communication systems, and seals used in underground mines) and controlling effects of coal mining on the environment.

- Local governments in southwest Virginia are encouraged to use local coalfield road-improvement funds to ensure that there are adequate roads to haul coal on routes that minimize conflict with built-up areas.
- Virginia's rail providers must ensure that there is adequate rail-car capacity to carry coal from Virginia's mines to end users and to Virginia's coal export facilities.
- Virginia should support carbon capture and storage projects in unminable coal seams to help support continued markets for Virginia coal.
- While Virginia should not take actions that would diminish the viability of southwest Virginia coal producers, Virginia coal consumers will benefit from the market diversity provided from coal imports. Therefore, state and local approval should be given to infrastructure improvements needed to modify existing coal export facilities to accept coal imports.

Recommendation: *Virginia should support development of fueling infrastructure as the market develops for hydrogen fuel use, as outlined in Virginia's hydrogen blueprint.*

- Hydrogen can become a larger provider of energy to Virginia.

However, it is not expected to be a major provider during the ten-year term of this Plan.

Recommendation: *Virginia should support industry efforts to ensure that the state's energy infrastructure is secure from natural and human-made disasters.*

- Virginia's energy industry should take the necessary steps to protect the state's energy infrastructure from risk of natural and human-made disasters.
- Energy infrastructure owners should invest in ongoing maintenance of facilities and rights-of-way, update controls and infrastructure to replace aging equipment and facilities, and harden existing facilities where needed for protection. Particular emphasis should be placed on central facilities such as power plants, bulk fuel storage facilities, and transmission infrastructure.
- State, local, and federal public safety and homeland security agencies should maintain clear communication with energy providers to develop and test response plans, and ensure coordinated response to any risks or incidents.

1.1.4 Energy, the Environment, and Climate Change

Energy use and production can affect Virginia's land, air, and water quality as well as wildlife and wildlife habitat. Energy production and consumption are significant factors in Virginia's air quality challenges. Fuel consumption accounts for the overwhelming majority of Virginia's sulfur dioxide, nitrogen oxides, mercury, and carbon emissions to the atmosphere. Emissions from energy production and consumption cause mercury, nutrient, and acid deposition and thermal inputs into Virginia's waters.

Energy consumption is the largest human-made contributor to greenhouse gas emissions. The Intergovernmental Panel on Climate Change's *Fourth Assessment*

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Carbon dioxide emissions rose in Virginia by approximately 34 percent from 1990 to 2004, a rate nearly twice the national average. This increase results, in part, from growth in Virginia's economy and development patterns that have produced sprawl and long commutes.

Report stated, with an increased confidence level over previous reports, that most of the observed increase in globally averaged temperatures since the mid-twentieth century is "very likely due" to the increased anthropogenic greenhouse gas concentrations.

Carbon dioxide emissions rose in Virginia by approximately 34 percent from 1990 to 2004, a rate nearly twice the national average. This increase results, in part, from growth in Virginia's economy and development patterns that have produced sprawl and long commutes. Virginia ranked in the top ten states with a 30 percent increase in gasoline-powered cars during this period.

What does climate change mean for Virginia? Over the long term, climate change will affect Virginia's population, wildlife, and economy. The Virginia Institute for Marine Science estimates that the Mid-Atlantic sea level will rise between 4 and 12 inches by 2030, threatening coastal islands and low-lying areas. Air and sea temperature changes would cause more frequent tropical storms, with increased damage to Virginia communities. Chesapeake Bay is particularly susceptible to damage caused by climate change. Changing rain and temperature patterns would disrupt agriculture and forestry.

Carbon dioxide emissions can be reduced by energy efficiency and conservation, using energy from sources that generate less carbon dioxide or are part of a closed carbon cycle, and carbon capture and storage. Methane emissions can be reduced by maximizing production of coalbed methane related to coal mining, by improving gathering, transmission, and distribution pipeline systems to eliminate leaks, and by increasing waste-to-energy development and landfill gas recovery.

Energy production often uses large amounts of water and large tracts of land. Point and non-point discharges from land disturbances for energy production, ranging from construction to agricultural practices growing energy fuels, can add to water quality problems. Electrical generation can affect large tracts of land for fuel storage, rail access, water for

cooling, and ash disposal. Wind-power sites, while small around each turbine, are often spread across large areas of land. Surface mineral extraction sites in Virginia can disturb large areas for mines, natural gas well sites, natural gas pipelines, and access roads.

There also is a link between land-use patterns and energy use. Suburban sprawl leads to increased automobile use and decreases use of lower energy-use alternatives such as transit, bicycling, and walking. Sprawl also requires extra investments in new energy infrastructure per household served. More efficient land development, such as that found in new urbanism-style development and high-density development around public transit nodes, will help slow growth of energy use in Virginia.

Energy efficiency and conservation have positive environmental impacts. Energy-efficiency and conservation practices reduce energy use and the resulting environmental impacts from energy generation.

Renewable energy production that offsets conventional energy production can reduce environmental impacts. Production of cellulosic energy crops can be used to reduce agricultural runoff. Production of algae as an energy feedstock can be used to manage nutrients in Virginia's waterways. Carbon capture and storage can be further developed to reduce the carbon emissions from conventional energy production.

There are several environmental programs that can help increase energy efficiency and renewable energy development. Renewable energy purchases can be used to offset nitrous oxide emissions under Virginia's ozone State Implementation Plan. Virginia's Clean Air Champions program includes driver education material about the importance of keeping vehicles maintained, with attendant air quality and energy impacts. Actions taken through other programs such as the Clean Cities, Cool Cities, Cool Counties, Climate Leaders, and Virginia Environmental Excellence Program all will help reduce energy use.

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Typical suburban sprawl in Virginia leads to increased automobile use and decreases use of lower energy-use alternatives such as transit, bicycling, and walking. Sprawl also requires extra investments in new energy infrastructure per household served. More efficient land development, such as that found in new urbanism-style development and high-density development around public transit nodes, will help slow growth of energy use in Virginia.

Goals for Energy, the Environment, and Climate Change

Reduce carbon emissions by 30 percent by 2025, to return to its year 2000 emissions level. Meeting the 10 percent electricity conservation goal and the 12 percent renewable portfolio standard goal for Virginia's investor-owned utilities in the 2007 electric regulation legislation, and achieving a 10 percent reduction in gasoline use in Virginia, would reduce carbon dioxide emissions by nearly 18 million tons per year, or approximately 15 percent of Virginia's total 2005 carbon emissions. Other actions will be needed if Virginia is to meet the 30 percent reduction goal.

This issue should be the subject of national policy because both the causes of, and solutions to, climate change transcend state and local boundaries. But, the magnitude of the problem is such that states can not simply wait for a federal resolution. It is hoped that these recommendations, and similar actions taken by other states and localities, may motivate a comprehensive national approach to this topic. Virginia stands willing to participate in the develop of such an approach and will work to harmonize our efforts with a reasonably aggressive national strategy.

Recommendations for Energy, the Environment, and Climate Change

Recommendation: Virginia should create a Commission on Climate Change to make a more comprehensive assessment of greenhouse gas issues and develop a plan for how to reach a greenhouse gas emission reduction goal.

- Specifically, the Commission would be charged with preparing a Climate Change Action Plan that would (i) calculate the size of and contributors to Virginia's carbon

footprint, (ii) address the effects of increasing atmospheric greenhouse gas concentrations on the state, (iii) identify what Virginia needs to do to prepare for the likely consequences of climate change, and (iv) identify what actions are needed to meet goals for reducing greenhouse gas emissions.

Recommendation: To help calculate Virginia's carbon footprint, the state should go beyond a voluntary reporting regime and require reporting of greenhouse gas emissions using The Climate Registry protocol.

Recommendation: Decisions on how Virginia will meet its future energy needs should be based on both costs of the energy sources and the need to protect ecosystems, natural resources, and the health and well-being of citizens, including economically disadvantaged and minority communities.

Recommendation: Development should be clustered, and infill and brownfield development should be encouraged to reduce energy impacts.

- Greenfield development, besides using open space and changing the environment, promotes increased energy use. Government policies should encourage developmen that allows for greater use of mass transportation, requires less new energy infra-structure, and provides for greater energy efficiency in the built environment.

Recommendation: Renewable energy production that offsets conventional energy production should be promoted to reduce environmental emissions. Carbon capture and storage should be further developed to reduce the carbon emissions from conventional energy production.

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Virginia's colleges and universities, federal laboratories, and businesses undertake a broad range of world-class energy research and development (R&D). These have the potential to lead to substantial new business activity in Virginia.

Recommendation: *Environmental programs should be leveraged to increase energy efficiency and renewable energy development.*

- This should include actions such as using renewable energy purchases to offset nitrous oxide emissions under Virginia's ozone State Implementation Plan.
- Consumer education should identify the environmental and energy effects of wise resource management.
- Virginia governments, businesses, and individuals should be encouraged to participate in activities under the Clean Cities, Cool Cities, Cool Counties, Climate Leaders, and Virginia Environmental Excellence Programs.

1.1.5 Energy Research and Development

Virginia's colleges and universities, federal laboratories, and businesses undertake a broad range of world-class energy research and development (R&D). These have the potential to lead to substantial new business activity in Virginia. Current university energy R&D strengths include coal use, fuel cells, alternate fuel development such as for cellulosic biofuels, and coastal energy.

Virginia is home to three federal laboratories that complete energy R&D activities. The NASA Langley Research Center conducts research on the impact of aviation on the environment and how alternative vehicles, fuels, and transportation systems can be made more efficient. The Thomas Jefferson National Accelerator Facility is involved in basic science related to atomic nuclei at the quark level. The lab has limited opportunities for applied research. Energy research at the Naval Surface Warfare Center, Dahlgren Division addresses the energy efficiency of weapons and electric guns.

Virginia's businesses undertake a wide range of energy-related research and development. Significant strengths exist in

the Areva NP/BWXT nuclear cluster around Lynchburg, at Northrop Grumman Newport News, at private technology businesses (particularly those serving federal clients), and at small businesses that have often spun off from university R&D.

Virginia faces a challenge coordinating these varied energy R&D activities in ways that increase their value to the Commonwealth. The state could create an energy R&D roadmap through which it would be able to better match areas of core strength with the best value proposition for investment in energy R&D and where it can make investments to facilitate competitive bids for federal energy R&D and leverage private investments. Virginia needs a governance structure for coordinating state energy R&D investments and activities.

Goals for Energy Research and Development

Increase investment in energy R&D by \$10 million per year, with half from state resources and half from private and federal resources. With this investment, Virginia will be able to attract federal and private investment in energy R&D and the state's businesses will be not left behind in the world marketplaces in which they compete.

Recommendations for Energy Research and Development

Recommendation: *Virginia should provide a consistent funding source for energy R&D and deployment.*

- State funding for energy R&D should be provided through a state energy R&D fund as a subset of the Commonwealth Technology Research Fund. It is estimated that \$5 million per year is necessary to build new research capacity and competitively respond to federal R&D grant opportunities.
- Initial priority areas for energy R&D

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The Commonwealth should provide start-up financial support to help Virginia become the home of businesses that bring new energy technologies to the marketplace and develop new innovative energy sources and infrastructure.

Energy businesses can add to Virginia's economic vitality.

investment include nuclear energy development associated with the nuclear clusters in the Lynchburg and Hampton Roads areas, alternate liquid fuel production from waste and cellulosic feedstock, coastal energy development from algae and wind, and carbon capture and storage in unminable coal seams.

Recommendation: *Virginia should establish a public-private governance structure to set priorities for public energy R&D funding.*

- Priorities for funding should be set using a governance system involving university, business, and government stakeholders based on a roadmap identifying the growth areas for energy R&D and areas where Virginia researchers can bring added value to these growth areas.
- The energy R&D governance system should be established as a virtual organization, named the Virginia Energy Research and Development Organization (VERDO), supported by resources within Virginia's energy research and government stakeholder organizations.
- VERDO should be a member of the Association of State Energy Research and Technology Transfer Institutions (ASERTTI).
- VERDO should host energy research showcases to connect technologies developed by Virginia's energy R&D organizations with venture capital firms and businesses with the resources to bring the ideas to market.
- This could be done solely with Virginia entities, but it might be more effective if undertaken jointly with neighboring states to become a Mid-Atlantic energy R&D showcase.

Recommendation: *Virginia should support development of two to three energy technology parks.*

As discussed below in Section 1.1.6, high-value focus for energy technology parks includes renewable fuels and fossil fuel production/carbon management.

1.1.6 Energy Economic Development

Economic development opportunities can come from energy-efficiency operations, provision of new energy infrastructure, activities to support environmental protection related to energy production and use, and through energy R&D actions.

Goals for Energy Economic Development

Support existing businesses wishing to make substantial new investments in energy activities, such as around the nuclear business cluster in Lynchburg.

Provide start-up financial support to help Virginia become the home of businesses that bring new energy technologies to the marketplace and develop new innovative energy sources and infrastructure.

These will provide a basis for new job growth and income to the Commonwealth. This should create an environment where Virginia's businesses are positioned to seize opportunities for innovative energy projects that can prove the viability of leading-edge technologies.

Recommendations for Economic Development

Energy businesses can add to Virginia's economic vitality. Today, coal and natural gas production provide the foundation for southwest Virginia's economy. Virginia's cost-competitive energy supplies provide a natural advantage to business recruitment and retention. Renewable energy supplies provide an opportunity for significant new job growth across the state. There are particularly good opportunities for new alternate liquid fuel-based job growth.

Recommendation: *Virginia should target its business development*

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actions to those energy businesses that produce real employment and capital investment gains.

- Virginia should refine its production grants for renewable energy businesses such as those for solar manufacturers and biofuel producers to ensure that the support meets business needs while providing a positive return on investment to the Commonwealth. This should include assistance needed to take advantage of the U.S. Department of Energy's clean energy loan guarantee and similar programs. Up to \$5 million per year is needed to fund these incentives and support other new energy business development.
- Virginia should form a multiagency Tiger Team of state-agency energy and economic development specialists to work with localities and industry partners to identify and package appropriate energy project sites.
- Virginia should increase support for energy research partnerships between its universities and businesses, and pursue opportunities to commercialize new technologies in partnership with Virginia businesses.
- Economic developers should work with the state's electric utilities and the State Corporation Commission to use existing authority to offer an economic development electricity rate for major energy-intensive projects.

Recommendation: Virginia should support growth of the state's nuclear industry cluster.

- Virginia should provide long-term financial support to the Center for Advanced Engineering and Research in Lynchburg. This effort should be designed to help solve the problems of a growing shortage of trained nuclear-industry workers.
- Virginia should assess the business opportunities that will come from decommissioning nuclear Navy ships and support development of the needed businesses to provide these services.
- Virginia should assess the potential

value of and regulatory needs for uranium production in Pittsylvania County.

Recommendation: Virginia should support development of new energy technology business parks.

- These parks should have combined heat and power and alternate liquid fuel development as their base tenants and include energy research and development and other energy businesses, providing for a sharing of common infrastructure to reduce overall cost to any single business. One target market for a plant could be alternate liquid fuels produced for military ground and ship transportation. A second high-value center for Virginia might be a fossil-fuel and carbon management center located in southwest Virginia.

Recommendation: Virginia should provide workforce services that support development of adequate numbers of trained workers for energy businesses.

- Virginia's community colleges and economic development officials should work with industries in their area to provide region-specific training programs for energy industry clusters. Examples include coal miner training provided by Southwest Virginia and Mountain Empire Community Colleges and industry-specific training provided through the Center for Advanced Engineering and Research in Lynchburg.
- Efforts to develop vocational training curricula should account for regional needs of energy providers. An example of such a program is the Kentucky Coal Academy's curriculum provided to coalfield high schools in Kentucky.

Recommendation: Virginia should address both the potential negative environmental impact and economic value when assessing whether projects impose a disproportionately adverse impact on economically disadvantaged or minority communities.

Chapter 1

Executive Summary

continued

Virginia can attract additional federal grants by providing funds for cost sharing and can attract private investment in energy projects through increased state support.

By heeding these calls to action, government, individual citizens, and businesses will use energy more wisely, have increased security from energy-driven disruptions, help ensure the availability of needed energy supplies to support the state's economy, and reduce the future impacts of climate change.

1.2 Conclusions

The recommendations of this Plan will help Virginians overcome barriers faced by consumers in making energy-efficiency and conservation improvements, add to Virginia's energy infrastructure, provide new energy supplies, support new business development, and expand research, development, and deployment of new energy technologies. Virginia can attract additional federal grants by providing funds for cost sharing and can attract private investment in energy projects through increased state support.

As discussed in various recommendations, achieving the goals of this Plan will require substantial annual investments by the Commonwealth, private business, and individuals. Estimated costs of these initiatives are summarized below.

- If Virginia is to meet its 10 percent electric savings goal by 2022, the Commonwealth's electric utilities will need to invest in the range of \$100 to \$120 million per year to support energy conservation programs. This would include costs of incentives, consumer education, and administration of energy-efficiency and conservation programs. Utility customers will have to match this investment with \$180 to \$200 million per year to cover their share of up-front energy-efficiency costs.
- \$5 million per year is needed for energy research and development to foster long-term improvements in how Virginia and the nation can supply and use energy more efficiently. This should be matched with at least an equivalent amount from private and federal sources.
- Renewable energy grant programs established in 2006 legislation and other efforts to expand use of renewable energy sources should be funded with \$5 million per year if we are to achieve a significant growth in renewable energy supplies.
- Up to \$5 million per year is needed to support energy business incentives, such as the Biofuels Incentive Grant Program; new technologies such as

waste, cellulosic, and coal-based liquid fuel production, solar panel and wind turbine manufacturing; and development of innovative energy sources and infrastructure such as combined heat and power projects and ethanol fueling stations.

- \$2 million per year is needed to expand the number of elderly and low-income families served by the Weatherization Assistance Program.
- \$1 million per year is needed for energy education to supplement utility-based consumer education programs and other smaller-scale energy projects.

Taken together, these recommendations will result in a substantial investment in new energy activities in Virginia. By heeding these calls to action, government, individual citizens, and businesses will use energy more wisely, have increased security from energy-driven disruptions, help ensure the availability of needed energy supplies to support the state's economy, and reduce the future impacts of climate change.